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ABSTRACT

The study reports the definition of programs of study which are homogeneous in the patterns of abilities and interests of their students and the grading standards of their faculties. It also presents data relating these programs to success, attrition, and transfer of the students who enroll in them. Curricula were grouped twice: first, according to academic similarity and, secondly, according to vocational and personal preferences. The subjects for this study were college freshmen for whom six academic variables were available for academic grouping: high school percentile rank, four American College Test scores, and first semester grade point averages. Interest grouping subjects (also college freshmen) had available data on ten Kuder occupational interest scales, six Kuder personal preference scales and the six academic variables. Results obtained from the use of Ward's hierarchical grouping analysis indicated that programs of study which are homogeneous in terms of the abilities, interests and college grades of their students can be identified, that these programs differ on at least two readily interpretable dimensions and that grouping of curricula on these bases simultaneously groups them according to sex ratio. (Author/MC)

PROGRAMS OF STUDY AS A BASIS FOR SELECTION, PLACEMENT AND GUIDANCE OF COLLEGE STUDENTS[1]

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A review of studies of attrition at campuses across the country revealed that the median rate of attrition for students enrolled in four-year college programs was 50% (Summerskill, 1967). If on the average 50% of the students entering an educational program fail to complete it then knowledge of attrition and transfer rates is essential to the process of educational planning. However, studies of collegiate success, attrition, and transfer are generally conducted at the all-university or all-college level, even though a university or college is likely to subsume curricula which are quite diverse in the patterns of abilities and interests which they demand, the strictness with which students are graded, and the academic facilities and faculties on which they draw. If such curricula vary in their attrition and transfer rates as well, then all-college statistics do not yield the needed information.

If programs of study sharing academic facilities could be defined, planning of educational programs could be based on specific attrition and transfer rates, educational outputs could be more easily regulated, and costs more readily assessed. If programs of study were defined which were homogeneous in terms of the abilities and interests of the students in them and the grading standards of their faculties, then the following desirable results might be expected: (1) more effective control of attrition through admission standards tailored to the homogeneous program of study, and (2) empirically based guidance of dissatisfied or unsatisfactory students into programs of study closely suited to their academic qualifications and

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their vocational interests. It is expected that homogeneity of abilities, interests and grading standards, on the one hand, and sharing of academic facilities, on the other, are very closely related phenomena and that programs of study homogeneous in the first sense will be homogeneous in the second as well. The present paper, then, reports the definition of programs of study which are homogeneous in the patterns of abilities and interests of their students and the grading standards of their faculties and presents preliminary data relating these programs of study to success, attrition, and transfer of the students who enroll in them.

METHOD

Curricula were grouped twice, once according to academic similarity and once according to similarity of vocational and personal preferences. Ss for the academic grouping were the 10,205 freshmen who entered the University of Illinois at Urbana in the fall of 1966 or 1967, for whom six academic variables were available: high school percentile rank (HSPR), four American College Test (ACT) scores, and first semester grade point average (GPA). Ss for the interest grouping and for subsequent analyses were the 4,673 freshmen who first enrolled at the campus in the fall of 1967 for whom scores were available on the 10 Kuder occupational interest scales and the 6 Kuder personal preference scales, as well as the six academic variables.

Ward's hierarchical grouping analysis (Veldman, 1967) was used to group the curricula into programs of study. For the academic grouping, the 85 curricula enrolling at least 26 Ss were grouped according to the similarity of their means on the six academic variables. The error index to be minimized in hierarchical grouping is the sum of the squared differences between corresponding scores in the profiles, i.e., curricular means, divided by the

number of objects to be grouped together. Since the means of the 85 curricula were based on quite disparate Ns, one set of means was used for each 50 Ss in the curriculum. The total set of means for each variable was standardized, with the result that each of the six variables was equally important in the grouping. Separate analysis of the academic and Kuder data prevented the 16 Kuder scales from contributing more to the grouping decisions than the six academic scales. Identical means were grouped together first, since the error index for these combinations was zero. The error indices for subsequent combinations were then dependent on curricular sizes as well as similarity of curricular means. Each of the 80 curricula with at least 13 Ss, with one set of means used for each 25 Ss in the curriculum, were grouped by the same procedure on the basis of the similarity of their 16 Kuder means.

The change in the error index with each successive combination of curricula was examined, and the grouping process was terminated at that number of groups beyond which recombination would lead to a relatively large increase in the error index. This procedure resulted in 11 academic groups and 10 interest groups. Each of the remaining small curricula, not used in the grouping process, was classified into that academic group on the basis of whose means and dispersion matrix the curriculum's six academic means yielded the smallest classification χ^2 (Cooley & Lohnes, 1962). This procedure was repeated, using Kuder scores, to classify small curricula into the Kuder groups, but with the restriction that a small curriculum could enter only those Kuder groups which, after all small curricula had been classified, would have at least ten Ss from the academic group to which the small curriculum belonged. In this manner, 39 groups of curricula were defined which differed from each other

in either their academic or Kuder classification, or both.

RESULTS

Discriminant analysis indicated that the 39 programs were highly discriminable on the basis of the 22 variables with $\Lambda = .160$, $F = 10.625$, $df = 836/88069$, $p < .001$.

Figure 1 indicates the positions of the means of the 39 programs on the first two discriminant dimensions and defines the programs in terms of their two largest curricula. Together the first two functions account for 64% of the total discriminating power of the test battery. Table 1 lists the

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first two scaled vectors and indicates that the largest contributors to group separation along the first function are Kuder Scientific, Computational and Mechanical scales and ACT Natural Science and Math, all positively weighted, and Kuder Social Service and ACT English, negatively weighted. High scores on scientific and quantitative interests and achievement scales yield a high score on function I, and high scores on social service interest and English achievement yield a low score on the function. In Figure 1 it can

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Insert Table 1
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be seen that the programs of study with high means on this function are made up of curricula such as engineering, chemistry, pre-med, etc., while programs of study with relatively low means on this function consist of teaching, English, and other verbally oriented curricula. This first function rather clearly separates scientific from verbal programs.

Heavy contributors to function II are HSPR, Kuder Scientific and Social Service, all positively weighted, and GPA, Kuder Verification and Kuder Directing and Influencing Others, all negatively weighted. The high positive weight for HSPR combined with the high negative weight for GPA suggests that programs with means which are high on this function enroll students whose GPA's at the University are low relative to their HSPR's, while programs with relatively low means on this function enroll students whose GPA's are higher than one would expect given their low HSPR. Thus this function appears to separate programs according to their competitive level. Examination of Figure 1 suggests that programs of study with means which are relatively high on this function are generally scholarly or professional in orientation: chemistry, physics, French, pre-nursing. Programs with relatively low means on this function are those which are oriented toward the business world or toward less academic activities: finance, industrial administration, aviation recreation and park administration.

Second semester performance data were available for the sample, allowing investigation of the academic drop and transfer rates within the programs. Table 2 presents correlations, for the 39 programs of study, among means on the first two discriminant functions, percent of students transferring to another program second semester, percent of students dropped for academic reasons during the first year, and percent of the students in the program who were male. Positive correlations of percent dropped, transferred and male with mean

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on the first discriminant function indicate that loss of students through drop and transfer is more common in the scientific than in the verbal programs and that the scientific - verbal continuum is very closely related to sex. The higher transfer rate for more scientific programs suggests a movement toward

more verbal areas. Indeed the mean for all transfers of the difference between original and final program mean on the first function was 1.124, suggesting an overall tendency for transfer to occur in the direction of the verbal curricula.

Negative correlations of percent dropped and percent male with mean on the second function indicate that the less competitive programs have higher drop rates and higher proportions of males than the more competitive ones. Although students in the less competitive programs earn GPA's which are high relative to their HSPR's, these GPA's are still low relative to the requirements for survival at the University. The very high correlation of maleness with the first discriminant function and the positive correlations between drop and transfer rates and percent male lead to the question of whether the relationships of drop and transfer rates to position on the discriminant axes are simply the result of differential sex ratios in the programs and a tendency for males to drop and transfer more than females.

Table 3 lists correlations, for the 33 programs in which both sexes were represented, between percent males dropped, percent females dropped, means on the two functions, and percent male. The data in Table 3 reveal that drop

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Insert Table 3
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rates within programs are uncorrelated for the sexes, that male drop rate tends to be higher in the more scientific and the less competitive curricula, with $R = .461$ ($p<.05$), and that female drop rate is not particularly predictable from either or both functions.

The extent to which transfer was predictable from discriminant scores on the first axis was investigated. The analysis was limited to the first

function because the second function had been found to be unrelated to transfer rate. Groups of at least five Ss who transferred from and to the same program were identified and their means on the first discriminant function calculated. It was expected that direction of transfer on the discriminant axis should be positively related to direction of the difference between the mean of the transfer group and the mean of the program of study from which they moved. Thus the difference between the mean of the transfer group and the mean of the program from which they transferred and the difference between the mean of the program to which they moved and the mean of the program from which they moved were expected to tend to be either both positive or both negative. Table 4 lists the results. Of the 22 transfer groups with at least five Ss, 16 moved the expected direction on the first axis. The phi coefficient for direction of transfer on the first axis, .542, is significant at the .05 level.

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The potential usefulness of the programs in predicting drop rates within colleges was assessed by regrouping the 39 programs into the original 11 academic groups and comparing drop rates within a college for students entering each of the academic groups represented within the college. Seven of the eight colleges at Urbana had more than one academic group represented within them, and of these seven, four had significant differences in drop rates ($p<.05$). These four include Liberal Arts and Sciences, the major college in terms of size. Homogeneity of the academic groups was tested by examining the drop rates of the colleges within them. Of nine academic groups so tested, those with more than one college represented in them, only two had significant differences among the drop rates of the colleges ($p<.05$).

DISCUSSION

The results of this study indicate that programs of study which are homogeneous in terms of the abilities, interests, and college grades of their students can be identified, that these programs differ on at least two readily interpretable dimensions, and that grouping of curricula on these bases simultaneously groups them according to sex ratio. The University has in recent years used HSPR and ACT Composite and no other variables such as interest scores, ACT subscores, or sex, in making admission decisions. Hence differences among programs in patterns of ability, interests, and sex are the results of self-selection. If the admission procedure were reorganized so that differential ability data were taken into account in the admission decision, program differences might become even more clearly defined.

The positive correlations of drop and transfer rates with the first discriminant axis indicate that attrition of these sorts is heaviest in the scientific curricula. If upperdivision spaces are filled in these curricula, the University must either be overadmitting freshmen into the scientific curricula or combating attrition by accepting transfer students, primarily from other institutions. In either case, the expenses involved, both human and institutional, in accepting, partially training, then dropping students could be decreased by increasing the level of selectivity in admission into these programs, possibly by holding admission open longer in these programs than in those to which suitable applicants need not be so highly qualified.

Loss due to transfer from the scientific to other programs probably acts as a control on enrollment within the more verbal programs. Data from other studies (e.g., Bowers & Mahan, 1968) indicate that while males

are more likely to be dropped than females, females are more likely to withdraw than males. Thus, the verbal, heavily female curricula can be expected to lose many students entirely from the system, whose places can conveniently be filled by emigrés from the scientific and technical fields.

The use of programs of study developed here as a basis for placement and guidance of students could be expected to decrease interprogram transfer rates, particularly in later semesters. Students tend to move in the right direction on the first axis without guidance based on these results. If guidance procedures were focused on directing students into programs with interest and ability profiles similar to their own, later transfers and re-transfers could probably be avoided. It should be noted that the uncorrelated nature of male and female drop rates within programs suggests that differential guidance procedures may be required according to sex.

A number of subsequent investigations are necessary in order to develop further the program of study approach. First, the extent of the overlap in academic facilities used by curricula within programs must be investigated. Second, the performance of the present subjects in later semesters must be traced in order to provide long-term attrition and success data and to allow the development of profiles of the aptitudes and interests of students who are, in the long run, both satisfied with and satisfactory within their programs of study. Finally, differential predictions of success and satisfaction within programs need to be developed for purposes of selection, placement, and guidance.

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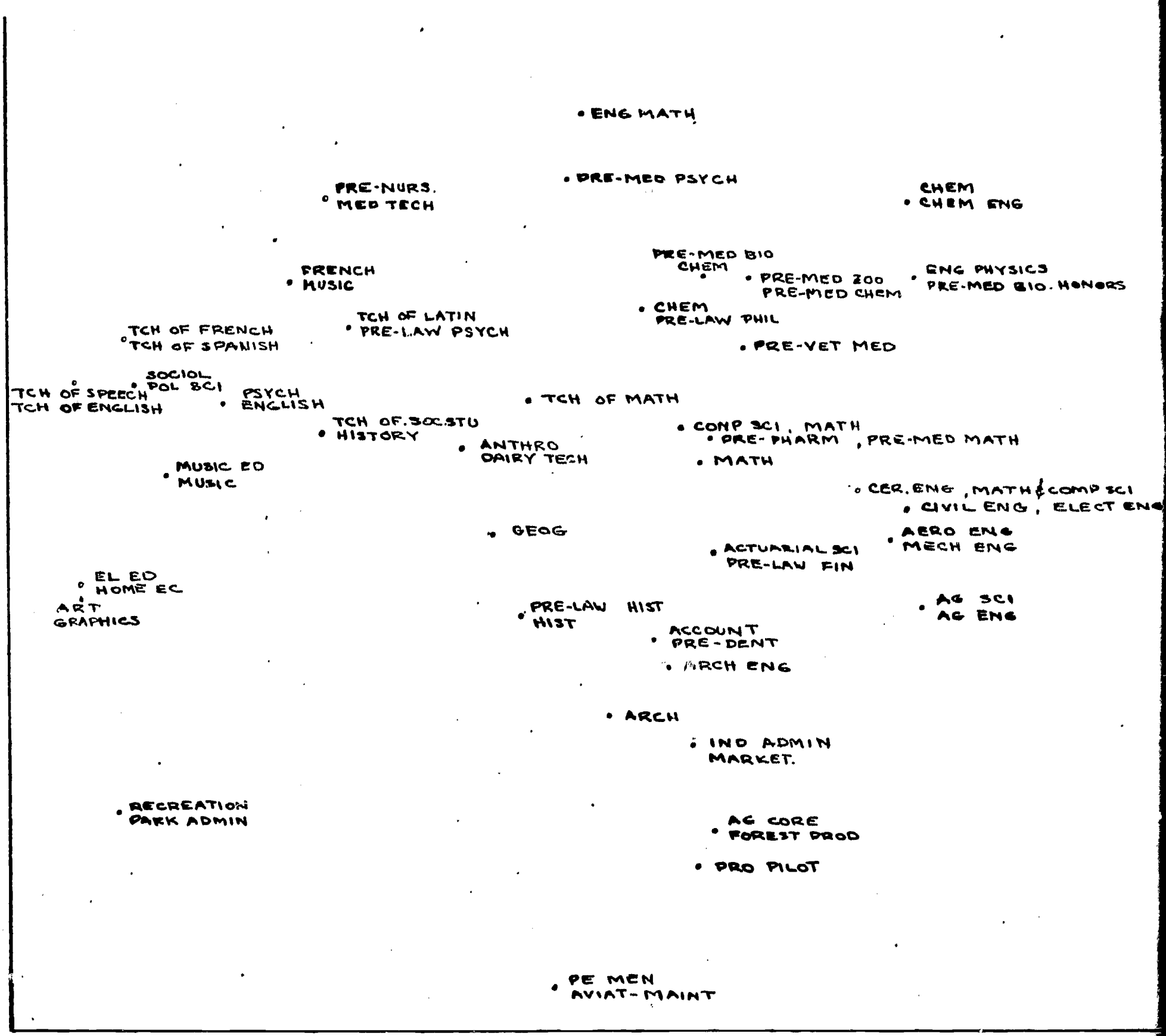

Figure 1. Means of Programs on First Two Discriminant Functions

Table 1

First Two Scaled Vectors

		I	II
1.	HSPR	12.134	84.497
2.	ACT:E	-55.738	36.359
3.	ACT:M	68.908	4.445
4.	ACT:SS	- 8.392	19.103
5.	ACT:NS	54.163	39.318
6.	GPA-I	-32.099	-38.81?
	Kuder Occupational Scales		
7.	Outdoor	12.606	- 7.534
8.	Mechanical	48.492	-18.697
9.	Computational	59.149	-16.140
10.	Scientific	175.227	89.340
11.	Persuasive	3.882	-16.211
12.	Artistic	-10.591	- 5.734
13.	Literary	9.017	19.765
14.	Musical	9.539	11.267
15.	Social Service	-42.931	54.800
16.	Clerical	- 8.592	9.646
	Kuder Personal Preference Scales		
17.	Being active in groups	-17.098	- 5.701
18.	Being in familiar, stable situations	22.758	- 9.833
19.	Working with ideas	-23.664	16.086
20.	Avoiding conflict	-40.459	18.497
21.	Directing others	23.970	-27.234
22.	Verification	25.805	-35.818

Latent Roots
λ_1 = 1.10218
λ_2 = .352677

Percent of trace:
1. 48.21
2. 15.43

Table 2

Correlations Among Drop and Transfer Rates, Sex Ratio, and Discriminant Means

		1	2	3	4	5
1.	$\overline{D}_1$	1.00				
2.	$\overline{D}_2$	-.015	1.000			
3.	Percent Dropped	.453**	-.353*	1.000		
4.	Percent Transferred	.430**	.015	.165	1.000	
5.	Percent Male	.857**	-.358*	.420**	.460**	1.0000

*p<.05
**p<.01

Table 3

Correlations Among Drop Rates for Each Sex, Sex Ratio, and Discriminant Means

		1	2	3	4	5
1.	$\overline{D}_1$	1.000				
2.	$\overline{D}_2$	.066	1.000			
3.	Percent Males Dropped	.321	-.309	1.000		
4.	Percent Females Dropped	.341	.161	-.010	1.000	
5.	Percent Males	.868**	-.212	.262	.154	1.000

$R_{4.12}$ = .368
$R_{3.12}$ = .461*
*p<.05
**p<.01

Table 4

Direction of Transfer on the First Discriminant Axis

		($\overline{D}_{\text{transfer group}}$ — $\overline{D}_{\text{original program}}$)	
		+	-
($\overline{D}_{\text{new program}}$	+	5	6
- $\overline{D}_{\text{original program}}$)	-	0	11

ϕ = .542, p<.05